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(58) Field of search
H2A
H2E
Selected US specifications from IPC sub-class H02K

(54) A disc type armature having insulating cutting correctors

(57) The armature has a commutator in which the commutator segments (34) are supported on a flat commutator support (14) in a single plane perpendicular to the axis of the armature so as to present a flat axially directed face to brush gear, and in which the commutator segments have integral terminals (36) which make a mechanical connection with insulated connector portions of the armature winding. Electrical contact is made between the connector portion and the terminal by the edges of a slot (48) which cuts through insulation of the connector portion as the slot is moved over the connector portion and which straddles and grips the connector portion to maintain the electrical contact. Alternatively, (Fig. 7) the connector portion is drawn into the slot. In this arrangement housing 18 may be omitted.

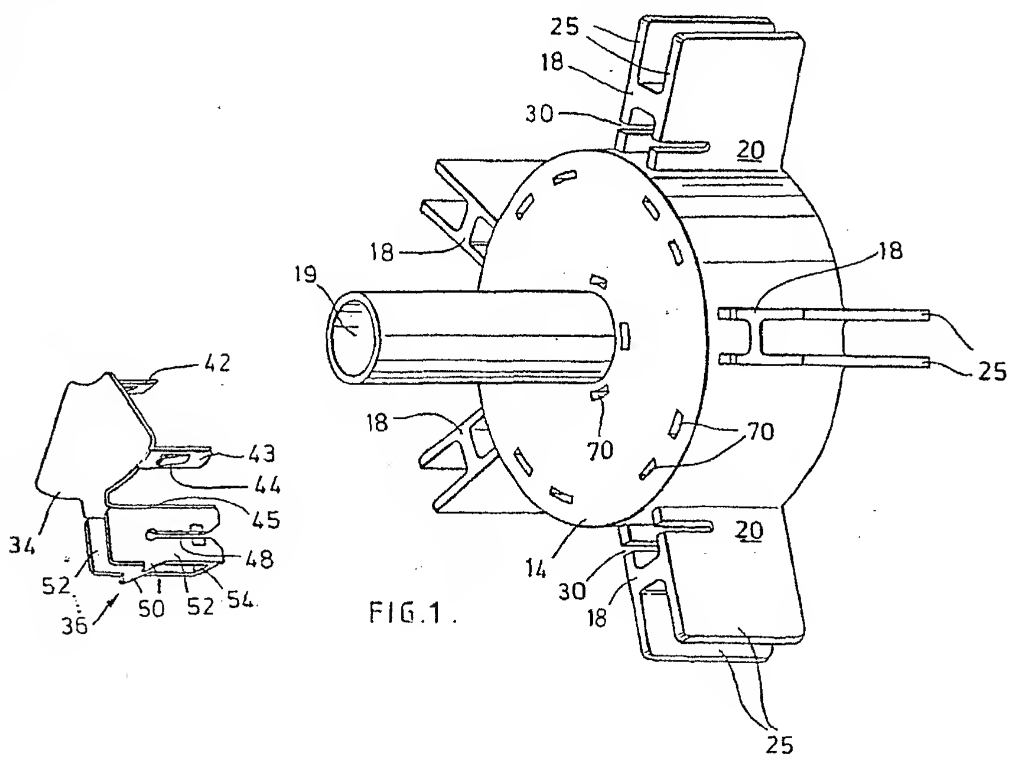

FIG.1.

The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1982.

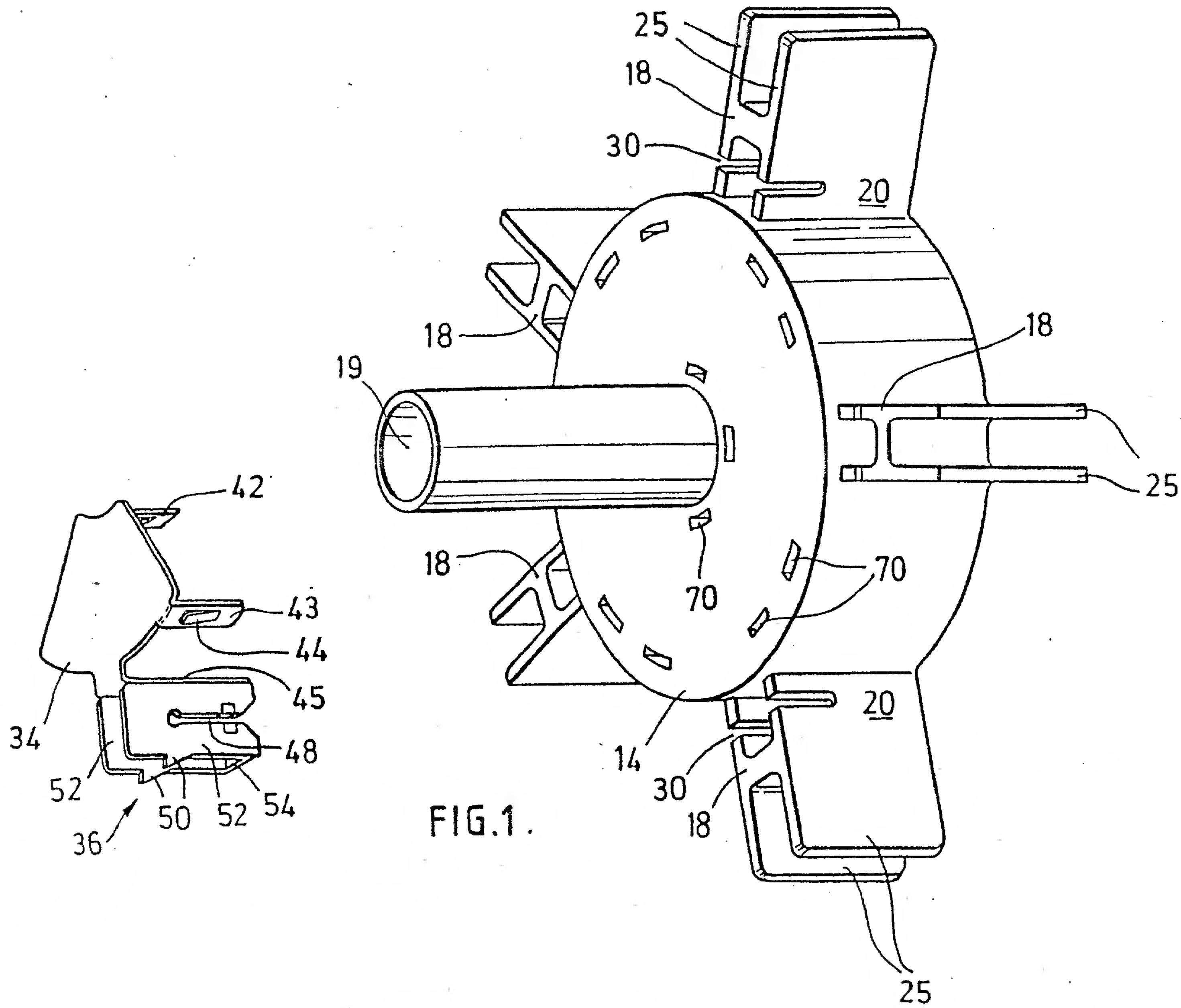

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FIG.1.

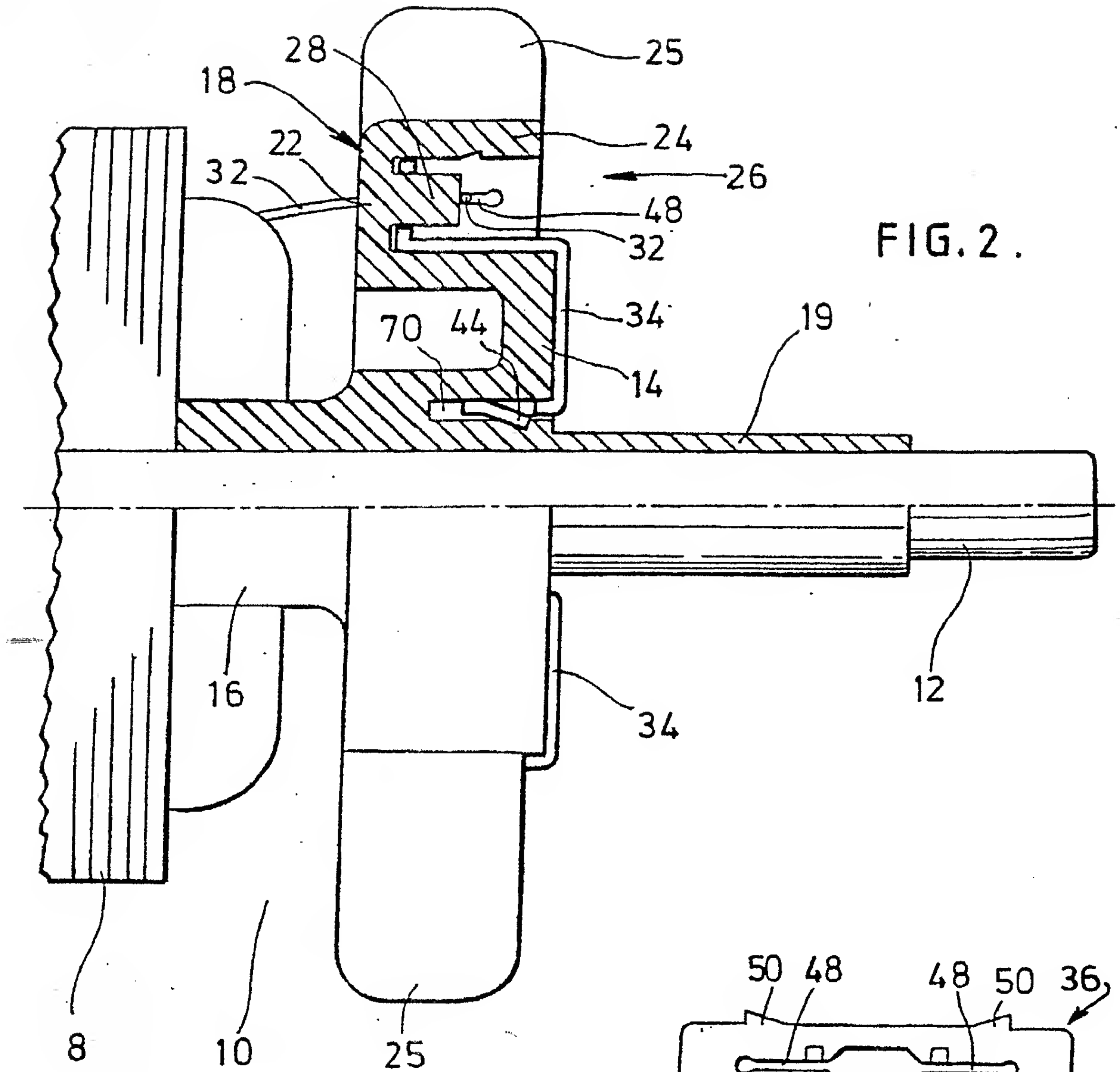
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FIG. 2.

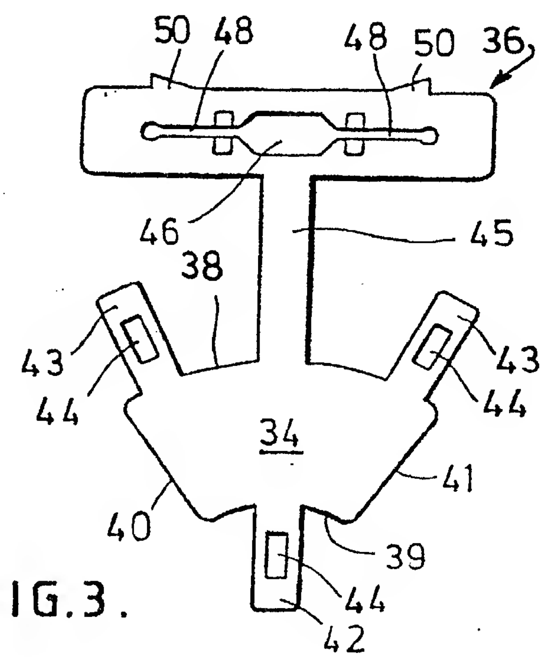
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FIG. 3.

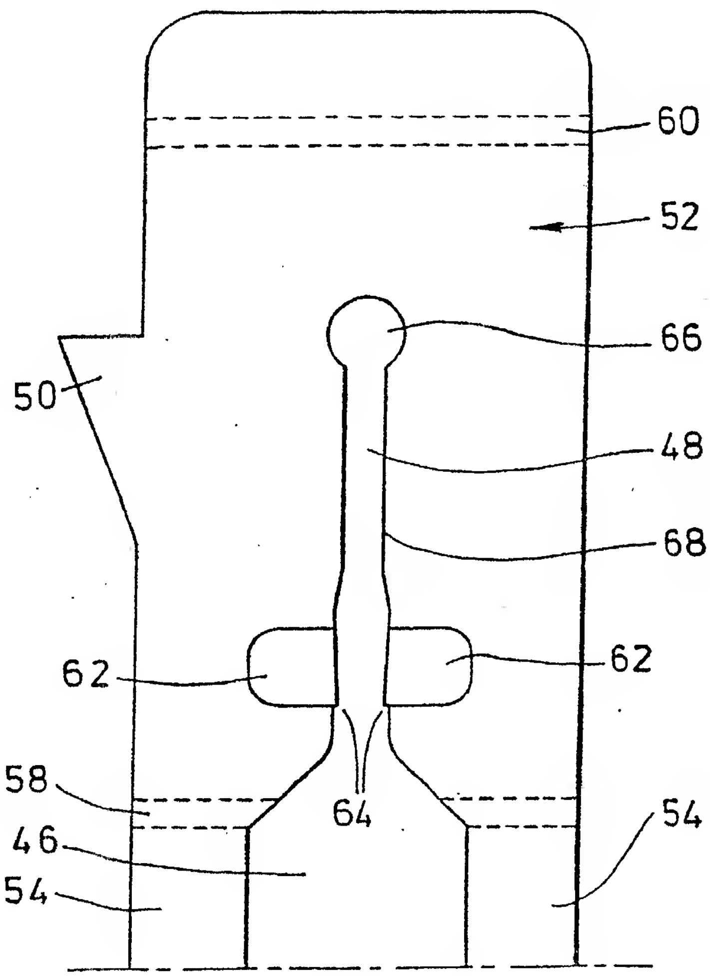

FIG.4.

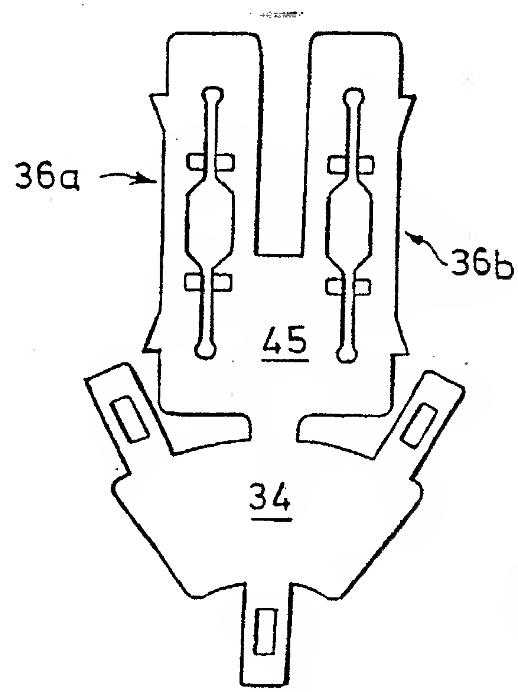

FIG.5.

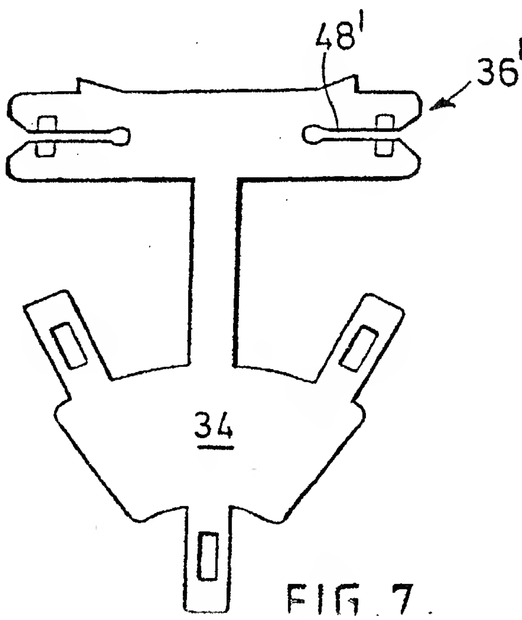

FIG 7.

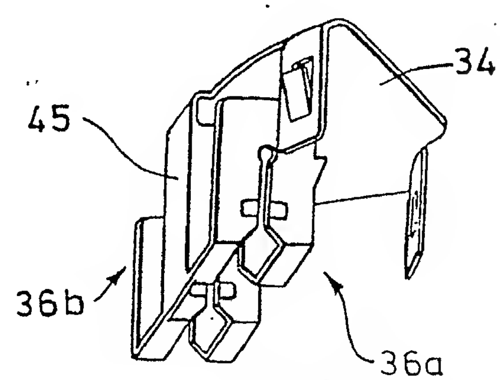

FIG.6.

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AN ARMATURE

The present invention relates to an armature for an electrical device.

It is common practice to use commutators in co-operation with brush gear to connect the armature of an electrical device to an external circuit. In the manufacture of such armatures it is necessary to provide an electrical connection between the armature winding and the commutator.

In our British Patent No.2128818B we describe a connection between the armature winding and an armature termination which avoids the application of heat to effect the connection and which utilises the principle of insulation displacement in which a wire having an insulating cover is forced into a slot narrower than the wire diameter to form a clean metal to metal contact between the wire and a terminal portion of the armature termination.

The commutator described in GB2128818B is of the barrel type, i.e. it comprises part-cylindrical commutator segments mounted on a cylindrical commutator base.

As higher energy magnets become available it is possible to reduce the lateral dimensions of the frame of an electrical device, e.g. an electrical motor, without reducing the power output. Brush gear used with barrel-type commutators approaches the commutator in a generally radial or tangential direction and the brush gear is therefore a limiting factor on the reduction in frame size.

According to the present invention there is provided an armature comprising a winding having connector portions coated with insulation, a commutator support, and three or more commutator segments seated on said commutator support and respectively connected to said connector portions of the winding, wherein the commutator support supports the commutator segments in a single plane perpendicular to the axis of the armature and wherein each commutator segment comprises an integral terminal provided with a slot which straddles and grips said connector portion, the slot having two cutting edges for cutting through insulation of the connector portion to establish electrical contact between the connector portion and the terminal and the slot being arranged to maintain the electrical contact between the connector portion

and the terminal as it straddles and grips said connector portion.

With such an arrangement the brushes can bear axially on the commutator and can be supported in cages at one end of the motor. The brush gear does not therefore impose constraints on the degree to which the lateral dimensions of the frame of the electrical device can be reduced.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is an exploded perspective view of a commutator segment and a commutator support of one embodiment of an armature according to the invention,

Figure 2 is a plan view of part of an armature assembly, partially sectioned to illustrate the configuration of one of the housings of the commutator support,

Figure 3 is a plan view of one combined commutator segment and terminal of Figure 1 in blank form,

Figure 4 is an enlarged view of part of the terminal shown in Figure 3,

Figure 5 is a plan view of another combined commutator segment and terminal in blank form,

Figure 6 is a perspective view of the commutator segment and blank of Figure 5 when bent to shape, and

Figure 7 is a perspective view of yet anothe. combined commutator segment and terminal in blank form.

Referring to Figures 1-4 of the drawings the armature shown therein has an armature lamination stack 8 and a body 10 mounted fast on a shaft 12. The body 10 is formed as a unitary plastics moulding although it could be formed of anodised aluminium, and includes a commutator support 14, a spacer portion 16, fiv housings 18 equally spaced around the circumference of the support 14 and a sleeve portion 19. The spacer portion 16 spaces the housing 18 from the base of the armature lamination stack 8 and each housing 18 is used in effecting connection between a respective portion of the armature winding and one of five commutator segments. The commutator support 14

has a flat commutator supporting surface which lies in a plane perpendicular to the axis of the armature.

One of the housings 18 is shown in section in figure 2. The housing 18 has side walls 20, an end wall 22 and a cover 24. The end wall 22 is adjacent the spacer 16 and an opening 26 which faces away from the spacer end of the body 10 is provided by the walls 20, 22 and cover 24. The side walls are parallel with the longitudinal axis of the body 10. Integral fan blades 25 project radially from the housings 18 to promote air flow across the armature.

A boss 28 projects centrally from the internal surface of the end wall 22 and extends within the housing 18 for approximately half the length of the side walls 20. The boss 28 extends parallel with the longitudinal axis of the body 10 and is only connected to the body 10 by the end wall 22. Each side wall 20 of the housing 18 has a slot 30 which extends parallel to the longitudinal axis of the body 10, from the commutator end of the housing 18 for a length which terminates at the level of the free end of the boss 28. A portion 32 of the armature winding is passed through the slots 30 of one of the housings 18 and the winding portion 32 rests on the end of the

boss 28. The external surfaces of the side walls 20 may be bevelled so as to facilitate entry of the winding portion 32 into the slots 30.

The combined commutator segment 34 and terminal 36 is best illustrated in figures 1 and 3. Figure 3 shows the combination in the form of a blank. The commutator segment 34 is in the form of a segment of an annulus and has two edges 38 and 39 which define concentric arcs of a circle and two radially extending edges 40 and 41. A lug 42 of reduced width projects forwardly from the edge 39 and two lugs 43 project radially from the edge 38. Each lug 42, 43 has a central struck-up tag 44.

At its rear end, the commutator segment 34 is connected to the terminal 36 by an arm 45. The terminal 36 is rectangular with its minor axis coincident with a line bissecting the commutator segment 34 and with the longitudinal axis of the arm 45. The terminal 36 has a central cut out portion 46 which is symmetrical with respect to both the major and minor axis of the terminal 36. The cut out 46 reduces from its largest width at the centre of the terminal to two key hole shaped slots 48 which terminate either end of the cut out 46. A triangular

barb 50 is provided on either side of the minor axis of the terminal 36 along the edge furthest from the commutator segment 34.

As can be seen from figure 1, the commutator segment 34 is bent at 90° to the arm 45. The lugs 42 and 43 project at right angles to the segment 34 so as to extend in a direction parallel to the longitudinal extent of the arm 45. Terminal 36 is bent upright with respect to the arm 45 and arms 52 of the terminal 36, which include the respective key hole slots 48, are bent at 90° to a central portion 54 of the terminal. The arms 52 therefore extend parallel to each other and to the longitudinal extent of the arm 45 and forward along the length thereof. Although not shown, the free ends of the terminal 36 may be bent so as to be inclined towards each other when the arms 52 have been bent parallel to each other.

Figure 4 shows one half of the terminal 46 of figure 3 on an enlarged scale. Areas 58 are shown in which bending occurs between the central portion 54 and the arm 52. Area 60 is also indicated in which bending between the arm 52 and the extreme end portion 56 may occur. However, the main purpose of figure 4 is to

illustrate the detailed structure of the key hole slot 48. It is this feature which ensures contact with the armature winding portion 32. The reduction in size from the centre of the cut out 46 to the start of the key hole slot 48 provides a funnel for guiding the arm 52 onto the winding portion 32. A short distance into the key hole slot 48 there are located two cutters 62 which have sharp edges 64 projecting into the slot 48. The cutters 62 ar formed from the arm 52 but are partially severed therefrom such that the sharp edges 64 are resiliently urged into the slot 48. Along the slot 48, behind the cutters 62, there is a further small reduction in width. Circular end 66 of slot 48 ensures that the edges of the slot 48 have a certain resilience to separation by the connection portion 32.

Figure 2 shows the commutator segment 34 and the terminal 36 in position on the body 10. The terminal 36 enters the housing 18 and the central portion 54 of the terminal 36 passes over the boss 23. The winding portion 32 is guided into the key hole slot 48. As the terminal 36 passes over the wire 32 the sharp edges 64 of the cutters 62 sever the insulation on the wire 32 and further entry of the terminal 36 forces the wire 32 into the narrow portion 68 of slot

48.

The slight resilience provided by circular portion 66 and the relative sizes of the wire and the section 68 ensure that the arms 52 continue to bear against the wire 32 with a residual spring tension which maintains high contact pressure ensuring a reliable long term connection.

The barbs 50 grip the cover 24 of the housing 18 and therefore retain the terminal 36 within the housing 18. Additional retention may be provided by contact between the central portion 54 of the terminal 36 and the boss 28. The arms 52 of the terminal 36 can be bent at an angle slightly less than 90° from the central portion 54 so as to provide retention of the terminal 36 by action against the side wall 20 of the housing 18. Further retention is provided if the width of the terminal 36 is a close fit to the internal dimensions of the housing 18.

The flat commutator support 14 is provided with recesses 70 which receive lugs 42 and 43 as the terminal 36 enters the housing 18. Tags 44 of lug 42 and 43 are forced into the material of the body 10 so as to rigidly restrain the lugs 42 and 43 within

recesses 70. Commutator segment 34 is rigidly held in position on the support 14 by interaction of terminal 36 and housing 18 and by interaction of lugs 42 and 43 and tags 44 with recesses 70. The commutator segment 34 is rigidly held on support 14 and there is no fear of displacement even during high rotational accelarations.

To assemble the armature, the body 10 is placed on the amature shaft 12 with the spacer 16 against th base of the lamination stack 8. The lead wire of the armature winding is inserted into the housing 18 by laying the end of the wire 32 in the slots 30 provided in the side walls 20 of the housing 18. The wire 32 is drawn back into the housing 18 until it rests against the boss 28. From this start, the first armature coil is wound. At the end of the first coil winding the armature is indexed and the wire 32 is layed in the same manner in the next housing 18 without breaking the continuity of the wire 32.

This process is repeated until all coils have been wound and the tail end of the winding is then laid in the slots 30 of the first housing 18 and pushed back until it is adjacent to the lead end which was placed

against the boss 28 at the beginning of the winding operation. The wire 32 is then cut and the armature removed from the winding machine.

The body 10 now has a winding portion 32 comprising insulated wire laying in each of the housings 18. Each of the winding portions 32 is under tension and is pulled tight against the respective boss 28.

Each combined commutator segment 34 and terminal 36 is prepared ready for insertion into the body 10. The commutator segments 34 then are moved towards the support 14 in a direction parallel to the axis of the armature so that the terminals 36 enter respective housings 18 and the lugs 42 and 43 enter respective recesses 70.

As the terminal 36 approaches the winding portion 32 held in the housing 18, the slots 48 move over the wire 32. The sharp edges 64 of the cutters 62 sever the insulation on the wire 32 which is deformed as the slots move over the wire 32. Intimate metal to metal contact is thereby provided between the wire 32 and the terminal 36.

The arms 52 of the terminal 36 act as double

canterlever springs and exert a continuous pressure on the wire 32.

The face commutator thus provided is in use contacted by brushes which bear axially on the commutator and which can be supported in cages at one end of the device. This can be of advantage, particularly in fractional horsepower p.m.d.c. motors especially as higher energy magnets become available allowing a reduction in the lateral dimensions of the motor frame for the same power output.

The connection between the armature winding and the commutator is simple and cheap. No application of heat is required and the associated risk of distorting the body 10 is therefore avoided. No embrittlement of the winding wire is caused and problems associated with oxidation are also avoided. The use of flux is negated and there is no chemical reaction or consequent corrosion resulting from the connection. The armature winding is a single continuous winding and the danger of introducing slack by breaking the winding to effect a connection to each coil is completely avoided. Consequently, the danger of the armature winding being fretted when the motor is in operation, is significantly reduced.

It should also be noted that the commutator segments 34 are introduced after the winding of the armature has been completed and therefore the danger of the wire being accidently stripped by abrasion on metal components during winding is very greatly reduced.

The commutator segment shown in Figures 5 and 6, differs from the above embodiment in that it has two integral terminals 36a and 36b which, as viewed in Figure 5, are connected to opposite edges of the arm 45 and which have major axes which are parallel to each other and to the longitudinal extent of the arm 45. The terminals 36a and 36b can be bent into the form shown in Figure 6 in which the terminals 36a and 36b are arranged directly below the commutator segment 34. In this case the housings for receiving the terminals will have to be provided within the commutator support 14. This will have the effect of reducing the overall diameter of the body 10. Moreover the wire will be straddled and gripped at four locations thereby ensuring better electrical contact between the wire and the commutator segment.

In some instances it may be desirable to assemble the commutator before winding the armature coils. In this case a combined commutator segment 34' and

terminal 36', as illustrated in Figure 7, may be employed.

In this case the slots 48 are replaced by slots 48' opening at opposite ends of the terminal 36' and the boss 28 in the housing 18 is omitted. The terminal 36' can be inserted in the housing 18 and the wire 32 can be drawn into the slots 48' at some subsequent time, preferably during an armature winding operation. The slots 30 in the housing terminate short of the circular ends of the slots 48' to prevent the wire 32 from being drawn into the circular ends. Cutting edges, as described previously, are provided within slots 48'.

This arrangement enables the commutator to be assembled prior to winding with the result that the commutator segments can be ground flat in isolation from the armature lamination stack.

Indeed in this arrangement it may be possible to omit the housings 18 altogether although some support for the terminal 36' is desirable.

Many other modifications could be made without departing from the scope of the invention defined by

the appended claims.

For example, the commutator segments could be bonded to the support 14 and the spacer 16 may include formations co-operating with complementary formations on the winding stacks, so as to prevent angular displacement between the body 10 and the armature stacks. The wire of the armature winding may be formed of a material such as aluminium instead of copper and various sizes of wire can be accommodated depending upon permissible deformation of the wire by the slots of the terminal arms 52. Moreover, instead of cutters 62, the edges of the slots 48 could be serrated. The terminal 36 could have just a single arm and barbs could be provided on the edges of the lugs 42 and 43 to improve the grip between the lugs and the support 14. Finally an annular varistor or resistive element could be mounted above the housings 18 for electrical connection to the terminals 36.

CLAIMS

1. An armature comprising a winding having connector portions coated with insulation, a commutator support, and three or more commutator segments seated on said commutator support and respectively connected to said connector portions of the winding, wherein the commutator support supports the commutator segments in a single plane perpendicular to the axis of the armature and wherein each commutator segment comprises an integral terminal provided with a slot which straddles and grips the connector portion, the slot having two cutting edges for cutting through insulation of the connector portion to establish electrical contact between the connector portion and the terminal, the slot being arranged to maintain electrical contact between the connector portion and the terminal as it straddles and grips said connector portion.

2. An armature as claimed in claim 1, wherein said terminal has two parallel arms, each arm having a slot which straddles and grips said connector portion.

3. An armature as claimed in claim 2, wherein said two arms are arranged in parallel and are connected

by a transverse portion.

4. An armature as claimed in anyone of the preceding claims, wherein the support includes three or more housings formed respectively with housing recesses for the terminals of the commutator segments.

5. An armature as claimed in claim 4, wherein the terminal is provided with a barb for retaining said terminal in said housing.

6. An armature as claimed in claim 4 or claim 5, wherein each housing has means for positioning a said connector portion of said winding relative to its housing recess and wherein the arrangement is such that each commutator segment can be positioned on said commutator support with a single translational movement, in which said commutator segment is brought to bear against the support and, at the same time, the cutting edges cut through the insulation of the connector portion positioned relative to said housing and the slot straddles and grips the connector portion to maintain electrical contact between the connector portion and the terminal.

7. An armature as claimed in anyone of the preceding claims, wherein each commutator segment has at least one lug which co-operates with a lug recess in the commutator support so as to locate and retain said segment on said armature.

8. An armature as claimed in claim 7, wherein each commutator segment has at least three said lugs, two at an outer edge and one at an inner edge.

9. An armature as claimed in claim 7 or claim 8, wherein the or each lug projects perpendicularly or substantially perpendicularly to said single plane.

10. An armature substantially as hereinbefore described with reference to and as shown in the accompanying drawings.